Power Electronics: Modular Multilevel Converter Prototype

Haley Fuller¹, Yicheng Wang²; Mentor: Shuyao Wang³
¹ Lenoir City High School ² Concord Christian School ³ University of Tennessee - Knoxville

INTRODUCTION: POWER ELECTRONICS

In electrical engineering, power electronics is defined as the study of controlling the flow of electrical energy with the help of electronic circuits. It also deals with the conversion of electrical power from one form to another.

HIGH-VOLTAGE, DIRECT-CURRENT (HVDC)

A high-voltage, direct-current electric power transmission system uses direct current for the bulk transmission of electrical power.

Advantages
- No technical limit to the length of a submarine cable connection.
- No requirement that the linked systems run in synchronism.
- No increase to the short circuit carrying capacity imposed on AC switchgear.
- No requirement that the linked systems run in synchronism.
- No technical limit to the length of a submarine cable connection.
- Improves both the AC system’s stability and, therefore, improves the internal power-carrying capacity.

HVDC APPLICATION

- Power transmission of bulk energy through long distance overhead cable or sea cable.
- Link renewable energy sources, such as wind power, when it is far away from the consumer.
- Two alternating current systems can be connected through a HVDC link without increasing short circuit power.
- Link systems with different frequencies using an Asynchronous Back-to-Back.
- Create a positive damping of electromechanical oscillations.
- Enhance the stability of the network by modulation of the transmission power by using a Back-to-Back.

MODULAR MULTILEVEL CONVERTER PROTOTYPE

A modular multilevel converter is a type of high-voltage, direct-current electric power transmission application that allows for an alternating current to be transformed into a direct current, thus allowing for more modern devices to be used. Each floor within the Cabinet has specific functions that allow for communication between each.

MAIN CONTROLLER BOARD

- Power Supply
  - Located in the upper right hand corner, the power supply produces 24 volts to power the entire board.
- Analog Input
  - Located at the bottom of the main controller board, an analog input converts a voltage level into a digital value that can be stored and processed in a computer.
  - Amplifiers are used to increase or amplify the voltage.
- Digital Input/Output
  - These are located on the upper left hand side of the board and are used to receive and transmit a digital signal.
- Optic Fiber Connector
  - Located on the left side of the main controller board lies the optic fiber connectors. These are used to transform information from one board to another in the form of light.

VOLTAGE SENSOR BOARD

- After being soldered, the voltage sensor boards are used to test the voltage.

CONCLUSION

Alternating current and direct current are different types of currents used for the conduction and transmission of electrical energy within an electric power system. Within power electronics, there is a major process where the alternating current must be transferred and converted into the direct current using different devices – in our case, the Modular Multilevel Converter – as most modern devices – including, yet not limited to batteries, power supplies, solar cells, and dynamos – require this so-called direct current for their operation. Alternating current is still used to deliver the electricity to the device, and an AC-to-DC converter is used along with the devices to convert alternating current power to direct current power so that these devices can use it. Without this conversion, most of the modern day technology would be unusable.